Environmental Engineering, Civil Engineering
Forensic Engineering, Construction Services

WINTER 2015 SOIL GAS AND INDOOR AIR SAMPLING PLAN

Former United Shoe Machinery Division North Parcel
181 Elliott Street
Beverly, MA

Prepared for:

Cummings Properties, LLC
200 West Cummings Park
Woburn, MA 01801

Prepared by:

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January 23, 2015

Winter 2015 Soil Gas and Indoor Air Sampling Plan for United Shoe Machinery Division North Parcel, Beverly, Massachusetts
Document Title

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1.0 SITE BACKGROUND AND HISTORY

1.1 Site Background

The former United Shoe Machinery (USM) Division North Parcel consists of approximately 80 acres at 181 Elliott Street in Beverly, Massachusetts. A Locus Plan is shown as **Figure 1** and a Site Plan as **Figure 2**. Cummings Center (the former USM Machinery Division North Parcel) constitutes only a portion of the entire property that was the former USM Machinery Division. The "South Parcel" of the former USM Machinery Division is located on the south side of Elliott Street (Route 62).

This site has been included in the U.S. EPA's RCRA 2020 Corrective Action Universe list. By the year 2020, EPA and the authorized states plan to have largely completed the work of implementing final remedies at all facilities requiring Corrective Action. This site is listed under the site number MAD 043415991 as USM Machinery Division. Massachusetts has not been given RCRA authorization for this site; therefore EPA is acting as the agency in charge for the RCRA program. As part of the RCRA 2020 program, EPA is overseeing an audit of the prior remedial actions. Despite that the site has undergone significant site assessment and remediation, the site is not listed as Remedy Construction in the RCRA 2020 database.

A Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP) dated July 30, 2012 was submitted to EPA and approved in 2012. This document included information on the proposed additional indoor air sampling activities to be implemented. Based upon review of the Site history and consideration of the current use of the Site, the primary question to be addressed by this investigation is whether potential volatile contaminant concentrations present a significant risk to the indoor air of the occupied buildings.

The Data Quality Objectives (DQO) for this investigation are designed to characterize the presence of volatile organic compounds in the indoor air in the occupied buildings and to determine if the presence of such compounds represents a significant risk to human health. Specific attention shall be given to the child, which represents the most sensitive receptor. Child day care and/or school uses currently occur in portions of Buildings 100, 500, and 600.

1.2 Site Indoor Air Sampling History

Previous investigations were conducted to assess indoor air quality in the buildings at the site. Such investigations involved the collection of soil gas data collected from soil borings installed underneath or adjacent to building footprints. In December 2004, soil gas probes were installed and soil gas samples were collected from around the exterior walls of Building 600 (see **Figure 2**). In February 2006, additional soil gas probes were installed and soil gas samples were collected from around the exterior walls of Building 600 and underneath the floor slab of

Building 500 (see **Figure 2**). Soil gas samples were analyzed using the TO-15 method for volatile compounds and the Massachusetts Air-Phase Petroleum Hydrocarbon (APH) method. The following compounds were detected during the 2004 and 2006 sampling events:

Acetone	Chloromethane	n-Hexane	Tetrachloroethylene
Benzene	Cyclohexane	2-Hexanone	Tetrahydrofuran
Bromodichloromethane	Dibromochloromethane	Isopropyl Alcohol	Toluene
1,3-Butadiene	1,1-Dichloroethane	Methylene Chloride	1,1,1-Trichloroethane
C_5-C_8 Aliphatics	Ethyl Acetate	Methyl Ethyl Ketone	Trichlorofluoromethane
C_9-C_{12} Aliphatics	Ethyl Alcohol	Methyl t-Butyl Ether	1,2,4-Trimethylbenzene
C_9-C_{10} Aromatics	Ethylbenzene	4-Methyl-2-Pentanone	1,3,5-Trimethylbenzene
Carbon Disulfide	4-Ethyl Toluene	Naphthalene	2,2,4-Trimethylpentane
Chloroform	Heptane	Propylene	Xylenes

Another investigation to address indoor air quality was performed in February 2008, when soil gas probes were installed around the exterior perimeter of Building 100. Soil gas samples were collected and analyzed using the TO-15 method for volatile compounds and the Massachusetts APH method. The following compounds were detected during the 2008 sampling event:

Acetone	1,1-Dichloroethane	n-Hexane	Tetrahydrofuran
C_5-C_8 Aliphatics	1,1-Dichloroethene	Isopropyl Alcohol	Toluene
C_9-C_{12} Aliphatics	Dichlorodifluoromethane	Methylene Chloride	1,1,1-Trichloroethane
Carbon Disulfide	Ethyl Alcohol	Methyl Ethyl Ketone	Trichloroethylene
Chloroethane	Heptane	Tetrachloroethylene	Trichlorofluoromethane
Chloroform			

Separate site-specific risk characterizations were performed using the 2004 and 2006 data for Buildings 500 and 600 and the 2008 data for Building 100. Risk characterizations were performed using the Method 3 protocols under the Massachusetts Contingency Plan. As actual indoor air data had not been collected at that time, applicable risk models were used to predict indoor air concentrations. These risk characterizations all concluded that there was no significant risk to human health (either to the child or adult) as a result of potential indoor air concentrations of volatile compounds based on the soil gas data.

The use of historical data as a baseline is appropriate as the purpose of this additional investigation is to determine if significant risk exists from compounds that may have been present during previous USM facility operations. The use of historic data would allow for the inclusion of degradation compounds of those volatile compounds previously detected as compounds of concern.

2.0 SUMMARY OF SAMPLING AND ANALYSIS PLAN AND PREVIOUS RISK CHARACTERIZATION

This Sampling and Analysis Plan was limited to the collection of air samples to establish conditions related to indoor air quality where children are present on the property for school or day care purposes. At the time of the QAPP preparation and collection of samples in 2012-2013, there were four locations on the property where such use was occurring (see **Figure 3**):

- Bright Horizons Children's Center
  100 Cummings Center, S-149-J

- Futures Behavior Therapy Center
  100 Cummings Center, S-157-J

- New England Academy
  500 Cummings Center, S-1100

- Beverly Children's Learning Center
  600 Cummings Center, S-171-X

Subsequent to the collection of the samples summarized in this section, the space in 500 Cummings Center, S-1100 is no longer occupied by the New England Academy or by another tenant where children are present for school or day care purposes.

Samples were collected during both summer and winter seasons to allow for seasonal variation. In addition, during each sampling event, one sample was collected from an exterior location to establish local ambient background conditions. The exterior location chosen was the roof of the North Parking Deck (250 Cummings Center). The above-described locations are shown in **Figure 3**.

During each sampling event, a Summa canister was placed at each of the five previously designated sampling locations. At one of the indoor sampling locations, a second canister was placed in order to collect a duplicate sample. The sample collection duration was approximately twenty-four hours.

Samples were analyzed for the following parameters:

- Air-Phase Petroleum Hydrocarbons (APH)
- Volatile Organic Compounds (VOCs) using EPA Method TO-15

Where feasible, sample analysis was performed in the SIM mode to obtain the lowest achievable (i.e., most conservative) detection limits.

The first round of sampling was initiated on September 20, 2012 and concluded on September 21, 2012. A second round of sampling was initiated on February 4, 2013 and concluded on February 5, 2013. Care was taken during the second round to place the canisters as close to the exact locations as previous canister placement during the September 2012 sampling event.

On May 24, 2013, a report titled "Indoor Air Sampling Analysis and Risk Characterization Report" was submitted to EPA. This report included the results of the sampling efforts in 2012 and 2013 and included a risk characterization of the indoor air data results to determine if a potential significant risk to human health was present from the indoor air pathway. The results were mostly consistent regardless of whether EPA or MassDEP risk factors were utilized. For excess lifetime cancer risk, there appeared to be no significant risk in any of the sampling locations. Moreover, no significant cancer risk was calculated at any of the sampling locations using detected compounds. Only in the scenario where *undetected* compounds were included in the evaluation and background levels were excluded was a significant cancer risk calculated (using EPA cancer slope factors). Under that scenario, the majority of the cancer risk was from three *undetected* compounds (1,2-dibromomethane, benzyl chloride, and vinyl bromide), and even the outdoor background sample had a calculated significant cancer risk. Overall, no excess cancer risk existed or exists in any of the sampling locations, regardless of whether the source of the detected contaminants is related to vapor intrusion, interior sources, exterior background air, or a combination of any of these.

For the non-carcinogenic hazard index, the risk characterization results across the various calculated scenarios were even more consistent regardless of whether EPA or MassDEP risk factors were utilized, undetected compounds were included in the risk calculations, or whether exterior background was considered. Under all evaluated scenarios, there was no elevated hazard index for Suite 149-J in Building 100, Suite 1000 in Building 500, Suite 171-X in Building 600, or in the exterior background sample. There was an elevated hazard index for Suite 157-J in Building 100, nearly all of which resulted from the concentrations of 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene (for the EPA risk calculation) and the concentrations of all three petroleum hydrocarbon fractions in the APH analysis (for the MassDEP risk calculation). 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are compounds typically found in petroleum hydrocarbons; MassDEP does not quantify them individually for risk purposes since their presence in already included with the risk of the APH.

When evaluating the data in Suite 157-J from September 2012 and February 2013, elevated concentrations of APH and trimethylbenzenes were detected in both sampling events. The conclusion from this assessment was that airborne petroleum hydrocarbons were present in Suite 157-J that could be considered to be potential significant risk concern, based on the calculation methodology used for this assessment. Given that the exterior background samples had little to no detection of APH or trimethylbenzenes, the source of the petroleum hydrocarbons was not suspected to be coming from the outside. Remaining potential sources of the petroleum hydrocarbons thus included interior source(s) within the suite space and vapor intrusion from the previous USM operations.

No further actions were recommended in Suite 149-J in Building 100, Suite 1000 in Building 500, or Suite 171-X in Building 600. Additional air sampling was recommended to evaluate the concentrations of petroleum hydrocarbons in Suite 157-J.

Additional indoor air sampling was collected in Suite 157-J in February 2014. For the February 2014 sample collection, sampling was limited to the Suite 157-J space in Building 100 and an exterior collection location. Due to the presence of snow and ice, the roof of the North Parking Deck was not accessible. The outdoor location was relocated to the roof of the West Parking Garage (see **Figure 3**). Previous sampling efforts had included only a single sampling location in Suite 157-J space. The previous sampling plan was revised to include three separate sampling locations within the space (see **Figure 4**). These sampling locations included:

- Administrative Office (noted as sample S-157-J). This is the same location used in the previous sampling efforts in 2012 and 2013.
- Activity room in central part of space (sample S-157-J.1).
- Activity room near eastern building exit (sample S-157-J.2).

A comparison of all indoor air samples collected in Suite 157-J between 2012 and 2014 is shown in **Table 1**. A total of six samples have been collected over that time period and the overall results show a relatively consistent indication of the indoor air quality in the space regardless of sample location or time of year collected. A total of 35 compounds have been detected in at least one sample in Suite 157-J; 24 of those compounds have been detected in all six samples. An additional four compounds have been detected in at least four of the six samples. For the compounds detected consistently, there has been little variation in the detected concentrations.

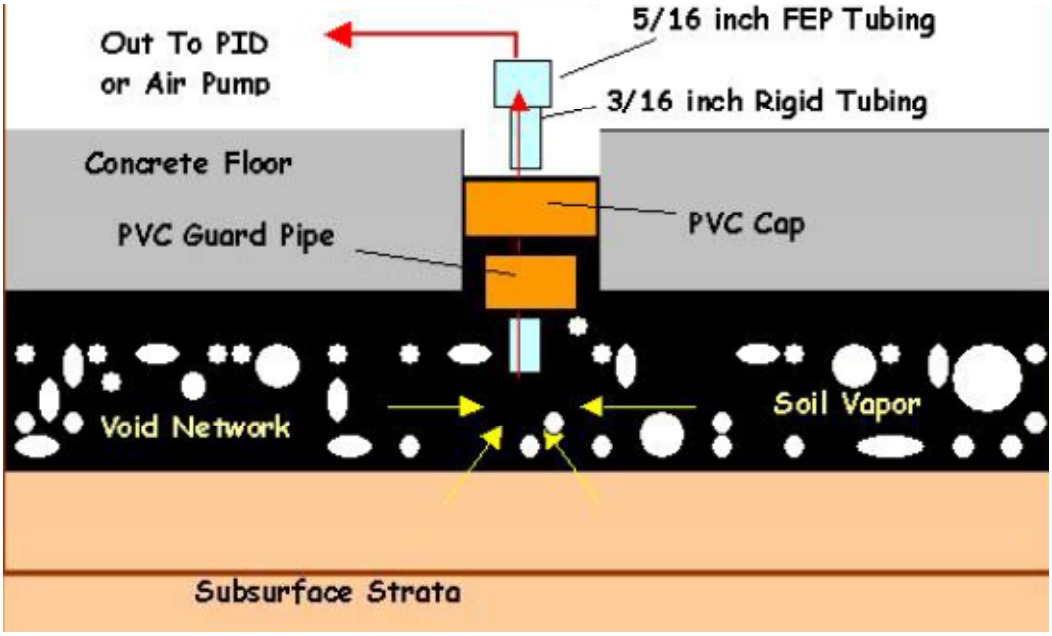
3.0 WINTER 2015 SAMPLING AND ANALYSIS PLAN

The next sampling event is scheduled for the winter of 2015. The exact schedule will be determined at a later date. EPA will be provided, as requested, with one week advance notice of the sampling event. Due to the consistent nature of the data and the continued presence of petroleum-related compounds that may result in a significant risk to human health, additional soil gas sampling will be collected in conjunction with the next indoor air samples to attempt to determine if the presence of such compounds is a result of vapor intrusion. Samples will be collected from a total of four soil gas point locations. These locations, shown in **Figure 5,** are essentially near the four corners of the space in question. As no definitive source for the petroleum or a suspected location of an old petroleum source has been determined, this is considered to be the best approach to determine whether or not the petroleum is present in significant concentrations in the soil gas that could correlate to the indoor air levels that have been observed. Until a correlation between the soil gas and the indoor air levels can be established, additional soil gas points are not viewed as prudent. Specific locations will be selected to minimize disruption to the operations in Suite 157-J. As feasible, points will be located in utility closets and/or rooms not in active day-to-day by the day care in Suite 157-J.

3.1 Soil Gas Point Installation

Each sampling port is anticipated to be installed as follows: 1) a 1-inch diameter hole will be drilled to a depth of 2-3 inches and vacuumed of debris; 2) a 3/8-inch diameter hole will be drilled through the concrete slab into the sub-slab material (vapor-barrier overlying well-graded, compacted backfill) and vacuumed of debris; 3) a 3/8-inch outer diameter polyethylene or similar rigid plastic piping will be inserted through a rubber stopper and into the 3/8-inch drill hole approximately 2-3 inches below the bottom of the floor slab; 4) the stopper will be placed at the bottom of the 1-inch drill hole and cemented-in with expanding hydraulic cement; 5) a vinyl cap will be placed on top of the rigid piping; and 6) a 1-inch diameter rubber expansion cap will be inserted into the hole.

A generalized design is depicted in the figure below.



Example of a Soil Gas Sampling Point (from Interim Final Vapor Intrusion Guidance December 2011, Massachusetts Department of Environmental Protection Policy WSC#-11-435)

Previous soil gas sampling at this site has shown that the floor slabs in Building 100 are up to four feet in thickness in certain areas. In addition, the groundwater depth has been shown to be shallow (less than one-foot depth). Previous soil gas points installed around Building 100 (from the 2008 sampling event) were abandoned and no soil gas could be collected due to a lack of vadose zone soil. The sampling locations depicted in Figure 5 may have to be moved if extensive floor slab thickness and/or a shallow groundwater table results in a flooded soil gas location.

A minimum of 24 hours will be allowed before sampling the newly installed points to allow for the concrete to dry and the soil gases to equilibrate.

3.2 Soil Gas and Indoor Air Sampling

After allowing at least 24 hours for the concrete to dry and the soil gases to equilibrate, soil gas samples will be collected using 2.7-liter glass-lined "Summa" canisters. These vacuum canisters will have pre-set, 30-minute regulators to collect a soil gas sample under low-flow conditions (0.09 liters/minute) in order to prevent short-circuiting the sub-slab soil gas air flow from beneath the concrete slab. A ¼-inch diameter FEP or similar rigid plastic piping will be connected to the 3/8-inch diameter sampling port tubing via a stainless steel coupling. The tubing will be connected to a photoionization detector (PID) with a 11.8 eV lamp, and the tubing will be

evacuated for approximately one minute while total VOC concentrations are recorded with the PID. The vacuum canister will be connected to the FEP tubing and the 30- minute regulator (with in-line particulate filter) will be opened and a soil gas sample will be collected, labeled, and logged. From each soil gas point, a single grab sample will be collected.

For indoor air sampling, the same protocols and sampling locations will be used as were used in February 2014. Standard operating procedures (SOPs) will be the same as those defined in Appendix A of the July 2012 QAPP. A total of three additional locations will be sampled inside the space with one duplicate sample collected. In addition, one outdoor background sample will be collected from the roof of the North Parking Deck or West Parking Garage. Indoor air samples will be collected using Summa canisters for approximately 24 hours in duration.

The collection of soil gas and indoor air sampling will occur concurrently. If feasible, the indoor air sample collection will begin on the same day as the installation of soil gas vapor points. Soil gas samples will then be collected on the next day when the indoor air sample collection period is complete.

Sample analysis for both the soil gas and indoor air samples will consist of the following parameters:

- Air-Phase Petroleum Hydrocarbons (APH)
- Volatile Organic Compounds (VOCs) using EPA Method TO-15

Sample analysis will be requested to be performed in the SIM mode to obtain the lowest achievable (most conservative) detection limits. In accordance with the APH analytical method, the potential identification of non-APH compounds (such as chlorinated solvents, ketones, and ethers) may represent an interference with the quantitative response within the aliphatic or aromatic hydrocarbon range. A specific request will be made for non-APH compounds to be identified in the laboratory report form or narrative, such that the data may be evaluated for such potential interference.

The reporting limits for this sampling effort are anticipated to be the same as with previous sampling efforts as described in the QAPP. Due to analytical detection limits, eleven compounds from the analyte list (1,1,2,2-tetrachloroethane, 1,2-dibromoethane, 1,4-dioxane, 3-chloropropene, benzene, benzyl chloride, bromodichloromethane, dibromochloromethane, hexachlorobutadiene, naphthalene, and vinyl bromide) have method detection limits that exceed EPA target risk values. Of these compounds, only benzene and naphthalene have been historically detected. Attempts will be made to improve on the detection limits if possible.

Figures

SITE COORDINATES
Longitude: -70.8871 W
Lattitude: 42.5596 N
UTM 4,713,634m N
345,086m E

Approximate Scale: 1 inch = 2,000 feet (1:24,000)

Figure 1 - Locus Plan

Project Number: 12201
Client: Cummings

Created By: EAF Date: 03/15/12
Checked By: BH Date: 03/15/12

Former United Shoe Machinery North Parcel
181 Elliott Street
Beverly, MA

Reference: MassGIS USGS Quadrangle: SALEM and MARBLEHEAD NORTH
Image: M/12201_Beverly/2012/Figures

Figure 2 - Site Plan

Former United Shoe
Machinery North Parcel
181 Elliott Street
Beverly, MA

BUILDING 200
BUILDING 800
BUILDING 100
BUILDING 900
EAST PARKING GARAGE
NORTH PARKING GARAGE
(Constructed after photo taken)
ELLIOTT STREET
BALCH STREET
WEST PARKING GARAGE
LOWER SHOE POND
BUILDING 600
BUILDING 500
UPPER SHOE POND
MCKAY STREET

LEGEND

Site Bound

N E S W

0 150 300 600
Feet

Approximate Scale: 1 inch = 300 feet

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave. - Exeter, NH 03833 - (603) 773-0075

Project Number: 12201
Client: Cummings

Created By: EAF Date: 03/15/12
Checked By: BAH Date: 03/15/12

Reference: MassGIS 2008 15CM Orthophotos
Image: M/12201_Beverly/2012/Figures

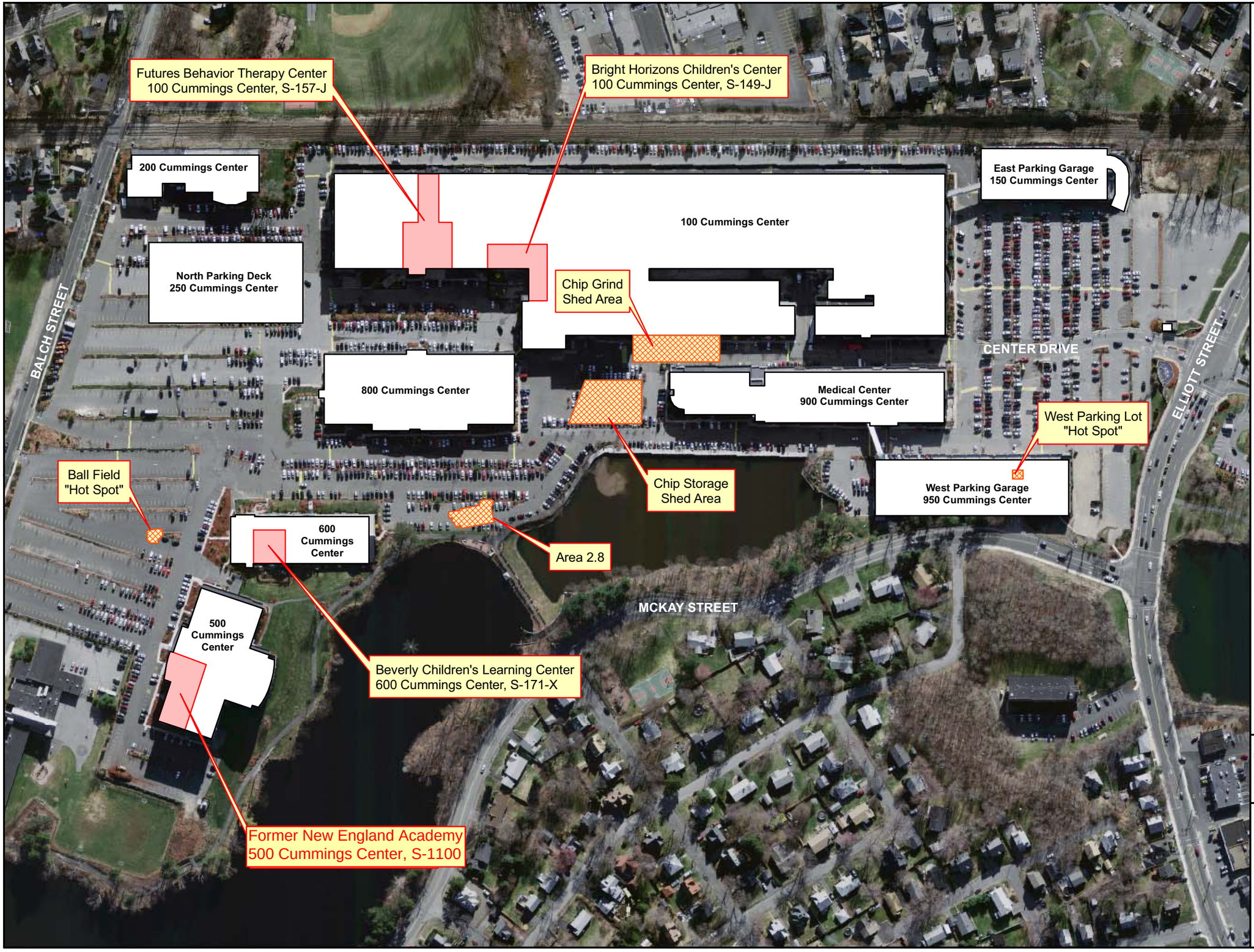


Figure 3
Building Areas Used As Child Day Care Centers Or Schools

Former United Shoe Machinery North Parcel
131 Elliott Street
Beverly, MA

LEGEND

- DAY CARE OR SCHOOL
- SOIL REMEDIATION AREA
- BUILDING

N E S W

0 100 200 400 Feet

Approximate Scale: 1 inch = 200 feet

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave. - Exeter, NH 03833 - (603) 773-0075

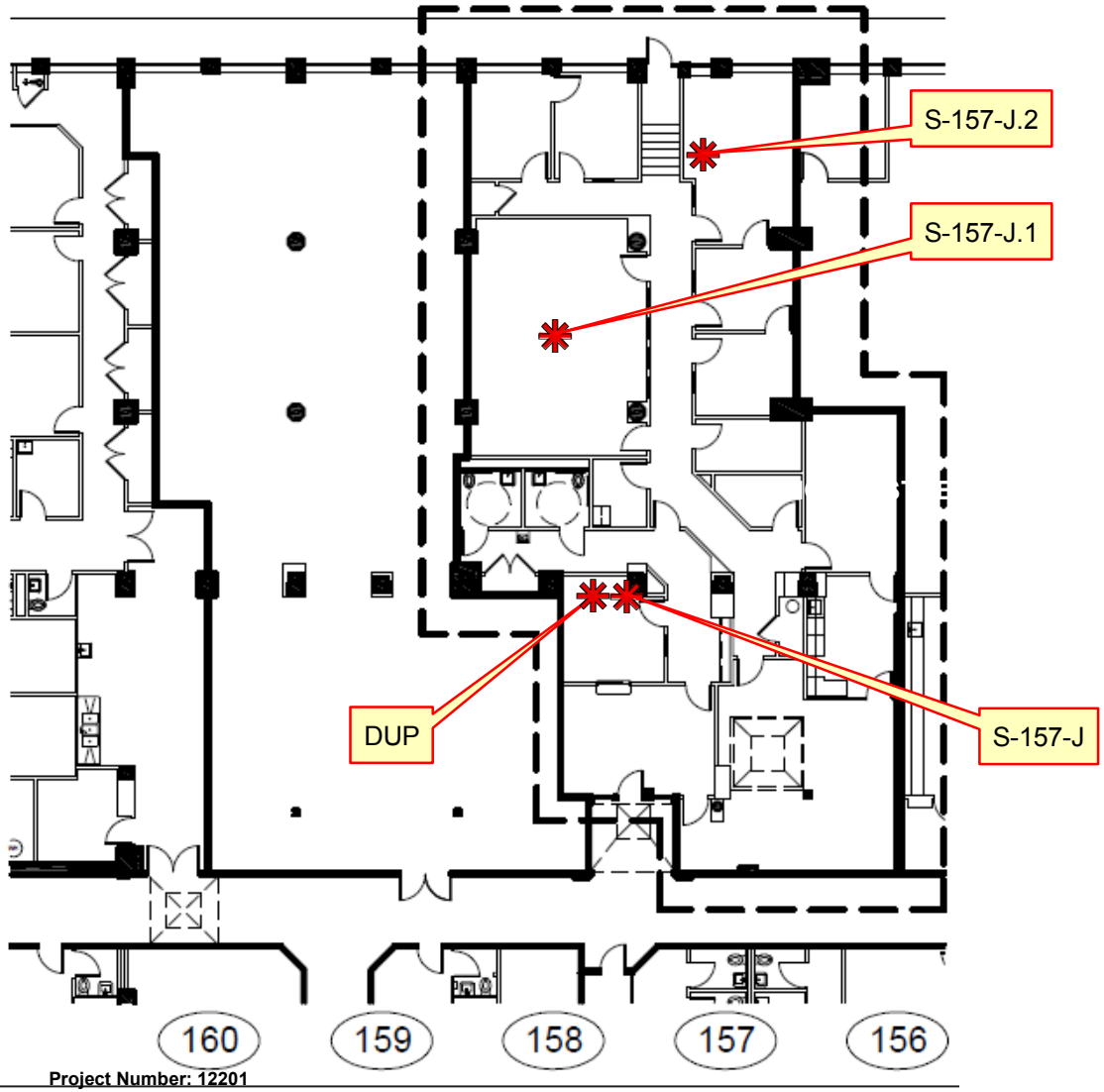
Project Number: 12201
Client: Cummings

Created By: EAF Date: 03/15/12
Modified By: AF Date: 04/15/13
Checked By: BAH Date: 04/15/13

Reference: MassGIS 2008 15CM Orthophotos
Image: M/12201_Beverly/2013/Figures

Figure 4
Indoor Air Sampling Locations

Futures Behavior Therapy Center
100 Cummings Center
(S-157-J)



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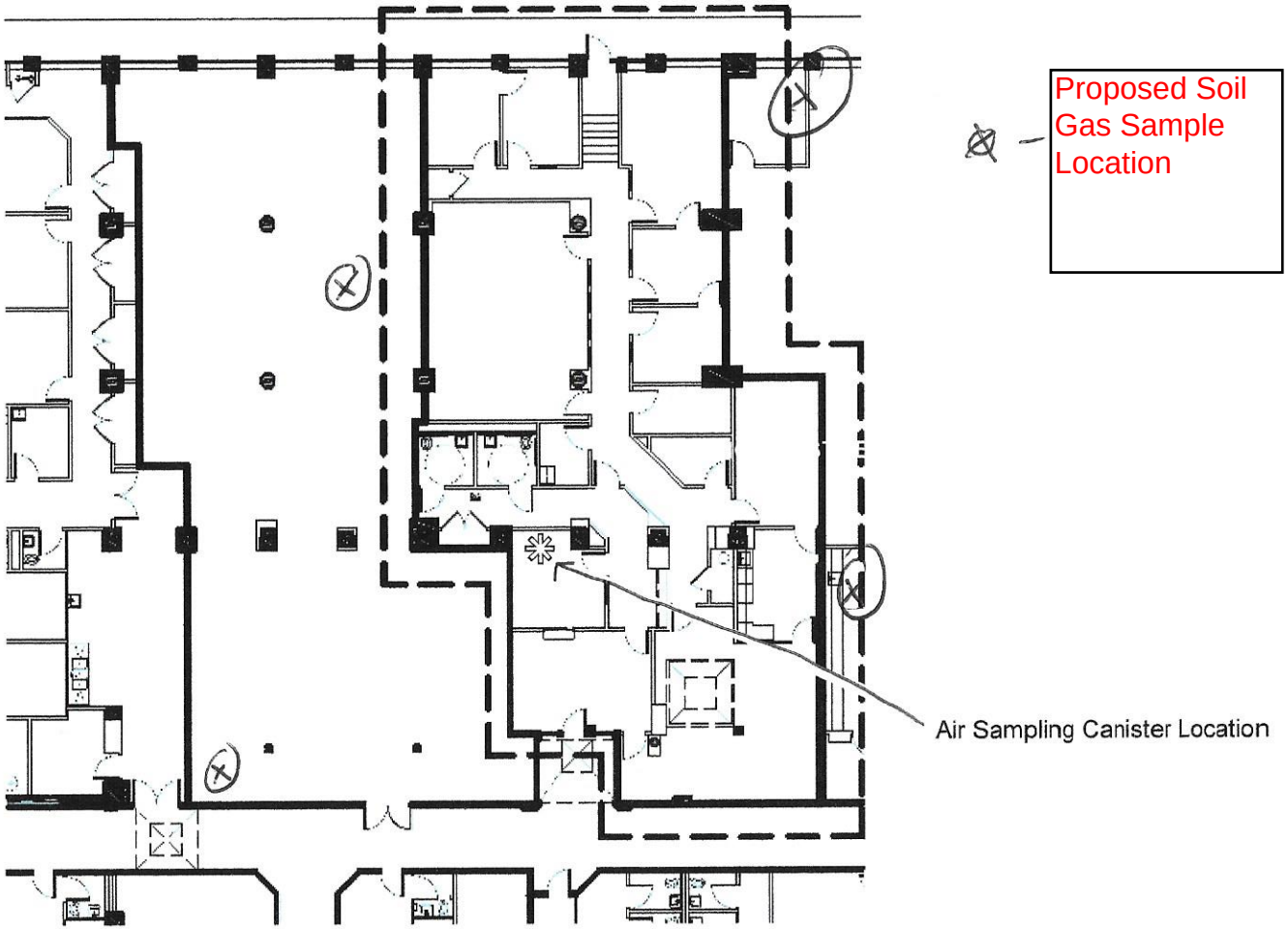
Reference:
Cummings Properties,
Engineering Plans, 05/27/2009

Figure 5
Air Sampling Location

Futures Behavior Therapy Center
100 Cummings Center
(S-157-J)



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51 Portsmouth Ave. - Exeter, NH 03833 - (603) 773-0075

Project Number: 12201
Client: Cummings

Created By: AF Date: 11/7/12
Checked By: BAH Date: 11/8/2012

Reference:
Cummings Properties,
Engineering Plans, 05/27/2009

Tables

TABLE 1

Comparison of Indoor Air Chemical Analysis Results - Building 100 Suite 157-J
Cummings Center, Beverly, MA
September 2012 to February 2014

Sample ID	S-157-J	S-157-J	S-157-J	S-157-J (Duplicate)	S-157-J.1	S-157-J.2		
Sample Location	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J		
Sample Type	Air	Air	Air	Air	Air	Air	EPA Target Risk: Carcinogenic =	MassDEP Residential Threshold
Date Sampled	9/20/2012 to 9/21/2012	2/4/2013 to 2/5/2013	2/7/2014 to 2/8/2014	2/7/2014 to 2/8/2014	2/7/2014 to 2/8/2014	2/7/2014 to 2/8/2014	1E-06 or HI = 1.0	Values
Volatile Organic Compounds (µg/m3)								
1,1,1-trichloroethane	<0.109	**0.109**	<0.109	<0.109	<0.109	<0.109	5200 (HI)	3
1,1,1,2-tetrachloroethane	<0.137	<0.137	<0.137	<0.137	<0.137	<0.137	0.33	
1,1,2,2-tetrachloroethane	<0.137	<0.137	<0.137	<0.137	<0.137	<0.137	0.042	0.04
1,1,2-trichloroethane	<0.109	<0.109	<0.109	<0.109	<0.109	<0.109	0.15	0.15
1,1-dichloroethane	<0.081	<0.081	<0.081	<0.081	<0.081	<0.081	1.5	0.8
1,1-dichloroethene	<0.079	<0.079	<0.079	<0.079	<0.079	<0.079	210 (HI)	0.8
1,2,4-trichlorobenzene	<0.371	<0.371	<0.371	<0.371	<0.371	<0.371	2.1 (HI)	3.4
1,2,4-trimethylbenzene	**19.8**	**54.6**	**19.1**	**22.8**	**22.4**	**22.9**	7.3 (HI)	
1,2-dibromoethane	<0.154	<0.154	<0.154	<0.154	<0.154	<0.154	0.0041	
1,2-dichlorobenzene	<0.12	<0.12	<0.120	<0.120	<0.120	<0.120	210 (HI)	0.72
1,2-dichloroethane	**0.227**	**0.093**	<0.081	<0.081	<0.081	<0.081	0.094	0.09
1,2-dichloropropane	<0.092	<0.092	<0.092	<0.092	<0.092	<0.092	0.24	0.13
1,3,5-trimethylbenzene	**5.21**	**13.5**	**5.6**	**6.69**	**6.49**	**6.69**	7.3 (HI)	
1,3-butadiene	**0.058**	**0.051**	**0.091**	**0.119**	**0.142**	**0.115**	0.081	
1,3-dichlorobenzene	<0.12	<0.12	<0.120	<0.120	<0.120	<0.120	200(HI)	0.6
1,4-dichlorobenzene	<0.12	<0.12	<0.120	<0.120	<0.120	<0.120	0.22	0.5
1,4-dioxane	NA	<0.721	<0.721	<0.721	<0.721	<0.721	0.32	0.59
2,2,4-trimethylpentane	<0.934	<0.934	<0.934	<0.934	<0.934	<0.934	N/A	
2-butanone	**2.04**	**1.04**	**4.39**	**6.1**	**6.37**	**6.02**	5200(HI)	12
2-hexanone	<0.82	<0.82	<0.820	<0.820	<0.820	<0.820	31(HI)	
3-chloropropene	NA	<0.626	<0.626	<0.626	<0.626	<0.626	0.41	
4-Ethyltoluene	**4.56**	**12.4**	**4.82**	**5.75**	**5.46**	**6.15**	N/A	
Acetone	**70.8**	**51.3**	**32.8**	**44.9**	**48.9**	**43.2**	32,000(HI)	91
Benzene	**0.323**	**0.696**	**0.795**	**0.843**	**0.974**	**0.93**	0.31	2.3
Benzyl Chloride	NA	<1.04	<1.04	<1.04	<1.04	<1.04	0.05	
Bromodichloromethane	<0.134	<0.134	<0.134	<0.134	<0.134	<0.134	0.066	0.14
Bromoform	<0.207	<0.207	<0.207	<0.207	<0.207	<0.207	2.2	2.2
Bromomethane	<0.078	<0.078	<0.078	<0.078	<0.078	<0.078	5.2(HI)	
Carbon disulfide	<0.623	<0.623	<0.623	<0.623	<0.623	<0.623	730 (HI)	
Carbon tetrachloride	**0.302**	**0.572**	**0.585**	**0.598**	**0.642**	**0.642**	0.41	0.54
Chlorobenzene	<0.092	<0.092	<0.092	<0.092	<0.092	<0.092	52 (HI)	
Chloroethane	<0.053	<0.053	<0.053	<0.053	<0.053	<0.053	10,000 (HI)	
Chloroform	**0.596**	**0.288**	**0.234**	**0.293**	**0.332**	**0.278**	0.11	1.9
Chloromethane	<1.03	<1.03	**1.05**	**1.23**	**1.32**	**1.11**	94 (HI)	
Cis-1,2-dichloroethene	**0.123**	**0.131**	<0.079	**0.099**	**0.111**	**0.095**	35 (HI)	0.8
Cis-1,3-dichloropropene	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	0.61	0.6
Cyclohexane	**56.4**	<0.688	**5.51**	**6.82**	**7.68**	**7.09**	6300 (HI)	
Dibromochloromethane	<0.17	<0.17	<0.170	<0.170	<0.170	<0.170	0.09	0.1
Dichlorodifluoromethane	**0.737**	**2.21**	**2.09**	**0.964**	**1.11**	**1.67**	100 (HI)	
Ethanol	**511**	**115**	**183**	**243**	**279**	**220**	N/A	
Ethyl acetate	<1.80	<1.80	<1.80	<1.80	<1.80	<1.80	N/A	
Ethylbenzene	**0.586**	**0.964**	**1.21**	**1.4**	**1.61**	**1.55**	0.97	7.4
Freon-113	**0.498**	**0.491**	**0.491**	**0.628**	**0.927**	**0.552**	31,000 (HI)	
Freon-114	<0.349	<0.349	<0.349	<0.349	<0.349	<0.349	N/A	
Hexachlorobutadiene	<0.533	<0.533	<0.533	<0.533	<0.533	<0.533	0.11	4.6
Hexane	**4.3**	**0.747**	**5.89**	**5**	**5.29**	**5.92**	730 (HI)	
Isopropyl alcohol	**235 E**	**396 E**	**178**	**256**	**244**	**219**	7300 (HI)	
Methylene chloride	**10.5**	<4.86	**39.6**	<3.47	<3.47	<3.47	94 (HI)	5
MIBK	**1.17**	<0.82	<0.820	<0.820	<0.820	<0.820	3100 (HI)	2.2
MTBE	<0.072	<0.072	<0.072	<0.072	<0.072	<0.072	9.4	39
M+p-xylene	**1.71**	**3.21**	**5.13**	**5.91**	**6.6**	**6.43**	100 (HI)	20
n-heptane	NA	<0.820	**1.19**	**1.42**	**1.8**	**1.7**	N/A	
Naphthalene	NA	**0.367**	<0.262	**0.267**	<0.262	<0.262	0.072	0.61
o-xylene	**0.96**	**2.34**	**2.55**	**3.01**	**3.11**	**3.15**	100 (HI)	20
Propylene	<0.86	<0.861	<0.861	**1.03**	**0.981**	<0.861	3100 (HI)	
Styrene	**0.588**	**0.379**	**0.179**	**0.213**	**0.341**	**0.26**	1000 (HI)	1.4
Tetrachloroethylene	**0.312**	**0.183**	**0.183**	**0.176**	**0.251**	**0.217**	0.41	1.4
Tetrahydrofuran	<0.59	<0.59	<0.590	<0.590	<0.590	<0.590	2000 (HI)	
Toluene	**2.67**	**2.51**	**2.88**	**2.52**	**4.56**	**5.58**	3200 (HI)	54
Trans-1,2-dichloroethene	<0.079	<0.079	<0.079	<0.079	<0.079	<0.079	63 (HI)	0.8
Trans-1,3-dichloropropene	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	0.61	0.6
Trichloroethene	<0.107	<0.107	<0.107	<0.107	**0.113**	<0.107	0.43	0.8
Trichlorofluoromethane	**1.15**	**1.26**	**1.35**	**1.7**	**1.82**	**1.49**	730 (HI)	
Vinyl acetate	NA	<0.704	<0.704	<0.704	<0.704	<0.704	210 (HI)	
Vinyl bromide	NA	<0.874	<0.874	<0.874	<0.874	<0.874	0.076	
Vinyl chloride	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051	0.16	0.27

TABLE 1

Comparison of Indoor Air Chemical Analysis Results - Building 100 Suite 157-J
Cummings Center, Beverly, MA
September 2012 to February 2014

Sample ID	S-157-J	S-157-J	S-157-J	S-157-J (Duplicate)	S-157-J.1	S-157-J.2		
Sample Location	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J	Building 100 Interior, Suite 157-J		
Sample Type	Air	Air	Air	Air	Air	Air	EPA Target Risk: Carcinogenic =	MassDEP Residential Threshold
Date Sampled	9/20/2012 to 9/21/2012	2/4/2013 to 2/5/2013	2/7/2014 to 2/8/2014	2/7/2014 to 2/8/2014	2/7/2014 to 2/8/2014	2/7/2014 to 2/8/2014	1E-06 or HI = 1.0	Values
Volatile Organic Compounds (µg/m3)								
Air-Phase Petroleum Hydrocarbon Target Analytes - APH (µg/m3)								
1,3-Butadiene	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.081	
Methyl-tert-butyl ether	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	9.4	39
Benzene	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.31	2.3
Toluene	**2.3**	**2.5**	**2.9**	**2.6**	**4.7**	**5.8**	3200 (HI)	54
Ethylbenzene	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.97	7.4
m- & p- Xylenes	<4.0	<4.0	**5**	**5.7**	**6.5**	**6.6**	100 (HI)	20
o-Xylenes	<2.0	**2.3**	**2.4**	**3**	**3.2**	**3.1**	100 (HI)	20
Naphthalene	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.072	0.61
Air-Phase Petroleum Hydrocarbons - APH (µg/m3)								
C_5-C_8 Aliphatic Hydrocarbons	**320**	**41**	**66**	**53**	**58**	**55**	N/A	58
C_9-C_{12} Aliphatic Hydrocarbons	**190**	**200**	**230**	**270**	**270**	**270**	N/A	68
C_9-C_{10} Aromatic Hydrocarbons	**61**	**160**	**61**	**72**	**71**	**74**	N/A	10

Notes:
Samples collected by Geosphere Environmental Management
Samples submitted to Alpha Analytical of Mansfield, MA
Results presented in µg/m3
NA - Not Analyzed
E - estimated
BOLD = Detected above laboratory standards
gray shaded = detected above applicable standard
blue shaded = analytical detection limit above applicable standard
< = not detected above laboratory detection limit shown
EPA Target Risk Levels are from Regional Screening Level Resident Air Supporting Table, November 2011. Values preceding "(HI)" indicate compounds that are not considered to be carcinogenic and risk levels are based on noncarcinogenic risk. "N/A" indicates compounds with no risk information available from this source.
MassDEP Residential Threshold Values are from Interim Final Vapor Intrusion Guidance, MassDEP Policy WSC# 11-435, December 2011.